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Finite Element Modeling of Ag Transport and Reactions in Chalcogenide Glass Resistive Memory HUGH BARNABY, ASU, ARTHUR EDWARDS, ARFL, DAVID OLEKSY, MICHAEL KOZICKI, ASU — Silver-based electrochemical memories show potential for non-volatile applications. While several groups have made significant strides in device development and process integration, challenges remain to improve function and reliability. The central problem is the large variability of operational parameters and programmed resistance. To understand these variabilities, we need to grasp the physics of conducting filament formation and dissolution. In this paper the mechanisms of Ag transport and reactions are modeled using a finite element device simulator. The ChG film is modeled as a wide-bandgap semiconductor with material constants (e.g., bandgap, permittivity, electron affinity) extracted from data reported in literature and the results of first principles density functional theory calculations. Active and inert electrodes are modeled as ideal metals with specified workfunctions. The code solves carrier statistics and transport equations (continuity, drift-diffusion, and Poisson) and, simultaneously, performs ion transport and reaction calculations. The chemistry captured by the simulator are the reduction/oxidation (RedOx) reactions, incorporated as generation (G) and recombination (R) terms in the continuity equations for both ionic and neutral Ag species in the ChG film. The results show how neutral Ag builds up in the film under applied bias. The simulations also reveal that the neutral Ag density is left unchanged once the bias is removed, which enables memristive action.

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